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Effect of increased nitrogen deposition on soil N cycle and microbial biomass and activity in a sessile oak forest

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In the past decades, nitrogen (N) deposition has increased due to human activities, providing an extra input of N to terrestrial ecosystems. The consequences of this additional N input on forest ecosystems have been studied in fertilisation experiments, simulating N deposition by applying mineral N to the forest floor. This approach does not consider the interaction with tree canopy, which has been shown to influence both the quantity and the chemical form of N reaching the forest soil. This may have led to biases in the experimental results. For this reason, in 2015 a N manipulation experiment was established in an oak (Quercus petraea Liebl.) stand in Bolzano (Italy) to investigate the effects of N deposition on temperate broadleaf forests. The experimental design consists in nine circular plots (12 m radius). Three plots were fertilised above the canopy (NAB), three plots below the canopy (NBL) and three were not fertilised (control). The fertilizer is applied 5 times during the growing season, for a total of 20 kg of N ha-1 year-1. This work presents results about soil N cycle and soil microbial communities. Nitrogen mineralisation and leaching were assessed through in-situ soil incubation, while the microbial biomass and activity were analysed through quantification of double-strain DNA (dsDNA) and enzyme activity. Results showed an increase of N leaching and a lower N mineralization under NBL treatment in comparison to the control. On the contrary, the NAB treatment did not affect significantly the examined N transformations. Soil enzymatic activity showed a tendency to decrease in both fertilization treatments (NAB and NBL), indicating a reduction of microbial activity induced by N. These outcomes suggest that the short-term response of forests to increased N availability can be different according to the fertilizer application strategy, confirming the importance to include the canopy in studies on the effect of N depositions on forests.